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[Title in German of the object of the invention:]

Vorrichting zur Anzeige von Zeichen und Symbolen

Application for patent examination pursuant to § 44 of the [German] PatLaw

DEVICE FOR THE DISPLAY OF CHARACTERS AND SYMBOLS

(57) Device for the display of characters and symbols by means of a multiple number of light emitters [luminous elements or illuminants], which are arranged in a matrix, in lines and columns, on a display board, and which can be activated or energized into a light emission, taking place in a frontal directional beam or pencil in different monocolors, respectively, whereby the light emitters with the different *n* monocolors are arranged in a geometrical combination into a so-called pixel, whereby the energizing of the light emitters takes alternatingly

place in the form of lines and columns, respectively, while the light emitters of the adjacent columns or lines are triggered or energized so that they are dark, characterized in that a multiplex mode of operation of a pixel occurs in such a way that *m* multiplex phases are provided,

that in each multiplex phase at least one light emitter of each pixel can be triggered or energized, and that in each multiplex cycle, each light emitter of a pixel can be activated or triggered at least once.

By means of this multiplex method, a high image quality is generated, while concurrently a minimization of the components and interconnections input.

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Description

The invention pertains to a device for the display of characters and symbols with the help of light emitters* [*Translator's note" Also known as luminous elements; illuminants, illuminators, or luminaries] in accordance with the preamble of claim 1, or 2.

Such devices are known, e.g., from the German 'Offenlegungsschrift' DE-OS 35 13 607 A1.

These display devices, which, e.g., comprise incandescent lamps or light-emitting diodes in their capacity as luminous bodies or light emitters [luminous elements], are rather used as information boards, e.g., for traffic information, timetables, display boards in stadiums and arenas or halls, and similar.

In such display systems, the individual matrix dots or image dots are materialized by means of a pixel, usually consisting of 4 or 5 light emitters, emitting light in different colors. In doing so, light emitters, emitting red light, green light and blue light are used in the prior art, which light emitters - according to the Theory of Colors*, devised by [one of the most famous German poets and writers, Johann Wolfgang von] Goethe - generate together a white light. [*Translator's note: major works: J. W. v. Goethe "Zur Farbenlehre" (Theory of Colors), Tübingen, 1810; J. W. v. Goethe, "Geschichte der Farbenlehre, I and II parts, Munich, 1963; J W von Goethe, "Zur Farbenlehre", didactic part, Munich 1963 etc.] When light-emitting diodes [LED] are used as a light emitters or luminous elements, four-unit or five-unit pixels are predominant, which consist of two red, one to two green, and a blue light-emitting diode structures.

In display devices, having relatively coarse raster , the light emitters are in most cases individually energized. When the resolution is higher, and, therewith, the raster is smaller, the pixels are energized or triggered in a multiplex mode of operation, i.e. the uneven pixel columns and the even pixel columns are alternatingly energized or triggered, or are activated in such a way that they are dark, respectively, so that

at a particular instant only each second column of the display device displays the corresponding image, which is to be represented, while the relevant other pixel column is switched so that it is dark.

Known is also the so-called micromirror principle in the case of smallest color screens in the magnitude of centimeters, whereby the color screen consists of a chip, which contains a large number of tiny mirrors, which can in such a way be controlled electrically that they reflect, or do not reflect, externally incident or incoming light. The externally incoming light can generate colored or black-and-white images by means of a kind of Nipkow*-disk, having red, green and blue permeability of the rotating disk, which is subdivided into sectors

[*Translator's note: The Nipkow-disk was invented by the German (Pomeranian-born) inventor and television pioneer Paul Julius Gottlieb Nipkow (1860-1940).]

Disadvantageous in the multiplexed display devices in accordance with the prior art is the occurrence of large brightness differences, which are pronouncedly perceived by the human eye, and are considered as very sensitive and delicate. As a result of the multiplexing of the individual pixel columns, the image appears as striped or striated to an observer. The said effect occurs as particularly pronounced when the observer moves, or when he/she glances or rather lets his/her glance skim over the display.

Therefore, it was an object of the invention to specify and

claim a device of the aforementioned kind, which device prevents larger brightness differences, when multiplexing is carried out, and, therewith, provides an opportunity for a better image quality.

The task thus set was achieved with the characteristic features of claim 1, respectively claim 2.

Advantageous designs of the invention ensue from the subclaims.

The advantages of the submitted display devices in accordance with the invention consist in that the image quality becomes significantly improved, while the striation effect or the stripe effect is eliminated. Another advantage consists in that the components output does not increases as a result of the multiplexing but when three- or higher phase multiplexing is used, can even be reduced. The invention utilizes the cognition that the human eye is much more insensitive to color fluctuations than for brightness fluctuations, as a result of which the color multiplexing in accordance with the invention cannot be perceived by the observer. Apart from the economizing of components, a reduction of the internal connections in the display is achieved by means of the color multiplexing in accordance with the invention.

The description of the invention follows by means of figures.

Fig. 1 shows the timing diagram of the color multiplex

operation, respectively the light-emitting diode operation of a four-unit pixel in accordance with claim 5.

Fig. 2 shows a timing diagram with the color multiplexing plotted, which color multiplexing corresponds to claim 8, and is based on the activation or triggering of pixels with the help of five light-emitting diodes.

In the lower part of Fig. 1, the energizing or activation of such a pixel, which consists of two red, a green, and a blue light-emitting diode, can be plotted by means of two periods T of the multiplex time, respectively can be perceived by means of light beams. In the upper part of Figure 1, which part is located above, the brightness is plotted as a function of the multiplex time. In a first phase, both of the red-light emitting light-emitting diodes are activated, which leads to a brightness of 30%. In a second phase-part of the multiplex time, a green diode is triggered to the multiplex period, which green diode furnishes about 60% of the brightness. Finally, the blue diode is activated in the third phase of the multiplex time. It furnishes 10% of the brightness. This is repeated in the subsequent periods of the multiplex time. On account of the individual values of the brightness of the red, green and blue light-emitting diodes in a multiplex period, there is generated 100% white. Indeed, in the case of a white image, the brightness fluctuates between 10 and 60% within such a multiplex period, which is indeed not yet optimal but from a standpoint of optics appears unmistakably

better than the multiplexing of the pixel columns in accordance with the prior art whereby a brightness fluctuation of 100% occurs spatially [or in three dimensions].

The lower part of Fig. 2 shows the activation of pixels with the help of five LEDs, plotted in this case as a function of the multiplex time of two periods T. In a first multiplex phase, the two red[-light emitting] LEDs are energized, which leads to a brightness of 30% (see the paragraph above). In a second multiplex phase, 50% current is applied to one of the green LEDs, which generates - as a result of this - also about 30% of the brightness while a blue light-emitting diode is concurrently also energized, which - with its 10% of the brightness - generates a total brightness of 40% in this phase. In a third phase, the other green LED is also energized with 50% of the current, as a result of which it also furnishes about 30% of the brightness. As a result of this, an additional improvement of the brightness difference of still only 10% is produced. Yet another division in half of the brightness difference is achieved as a result of the fact that in the second phase, the green light emitting diode is supplied with only 25%, and, for that reason, the other green diode is energized with 35% of the brightness current. As a result of this, the brightness over two multiplex phases remains constant, and drops only in the third phase by about 5%.

PATENT CLAIMS

1. Device for the display of characters and symbols by means of a multiple number of light emitters [luminous elements], which are arranged in the form of matrix in lines and columns on a display board, and can be activated or energized into a light emission, taking place in a frontal directional beam or pencil in different monocolors, respectively, whereby the light emitters with the different monocolors are respectively arranged in a geometrical combination into a so-called pixel, whereby the energizing of the light emitters takes alternatingly place in the form of lines and columns, respectively, while the light emitters of the adjacent columns, resp. lines, are triggered or energized so that they are dark, **characterized in that** a multiplex mode of operation of a pixel occurs in such a way that in each multiplex phase at least one light emitters of each pixel can be energized, that in a first multiplex phase, the light emitter of a first monocular, while in a second multiplex phase, the light emitter of a second monocolor, and in a n^{th} multiplex phase, the light emitter of an n^{th} monocular can be energized.

2. Device for the display of characters and symbols by means of a multiple number of light emitters, which are arranged on a board in lines and columns, in the form of a matrix, and can be energized into a light emission taking place in a frontal directional beam or pencil in different colors, respectively,

whereby the light emitters with the different monocolors are respectively arranged in a geometric combination into a so-called pixel, whereby the energizing of the light emitters takes alternatingly place in columns and lines, respectively, while the light emitters of the adjacent columns, respectively lines, are switched so that they are dark, characterized in that a multiplex mode of operation of the light emitters of a pixel occurs in such a way that there are provided *m* multiplex phases,
that in each multiplex phase at least a light emitter of each of the pixels can be activated, and

that in each multiplex cycle, each light emitter can be activated at least once.

3. Device, as claimed in claim 1 or 2, characterized by the use of light-emitting diodes [LEDs].

4. Device, as claimed in one of the preceding claims, characterized by the use of basic colors red, green and blue in their capacity as monocolors.

5. Device, as claimed in claim 1, 3 and 4, characterized in that $n = 3$ multiplex phases are provided,

that in a first multiplex phase, there are provided two light-emitting diodes, emitting red light,

in a second multiplex phase, there is provided a light-emitting diode, emitting green light, and

in a third multiplex phase, there is provided a light-emitting diode, emitting blue light (Fig. 1).

6. Device, as claimed in claim 2, 3 and 4, characterized in that in at least one of the m multiplex phases, at least two light emitters of the same or different monocolors can concurrently be energized or activated.

7. Device, as claimed in claim 6, characterized in that light emitters can be energized with different current intensity (amperage).

8. Device, as claimed in claim 7, characterized in that $m = n = 3$ multiplex phases are provided,

that in a first multiplex phase, there can be energized two light-emitting diodes, emitting red light,

that in a second multiplex phase, a light-emitting diode, emitting green light can be energized as far as 50% of the green brightness, required for white, and a light-emitting diode, emitting blue light, can be energized, and

that in a third multiplex phase, a light-emitting diode, emitting green light, can be energized as far as 50% of the green brightness, required for white.

9. Device, as claimed in claim 7, characterized in that the light emitters can be activated or energized in such a way that the brightness differences, brought about as a result of the multiplexing, can be minimized.

Legend to the drawings:
Zeit = Time; Rot (R) = Red; Grü (G) = Green; Blau (B) = blue
Helligkeit = brightness

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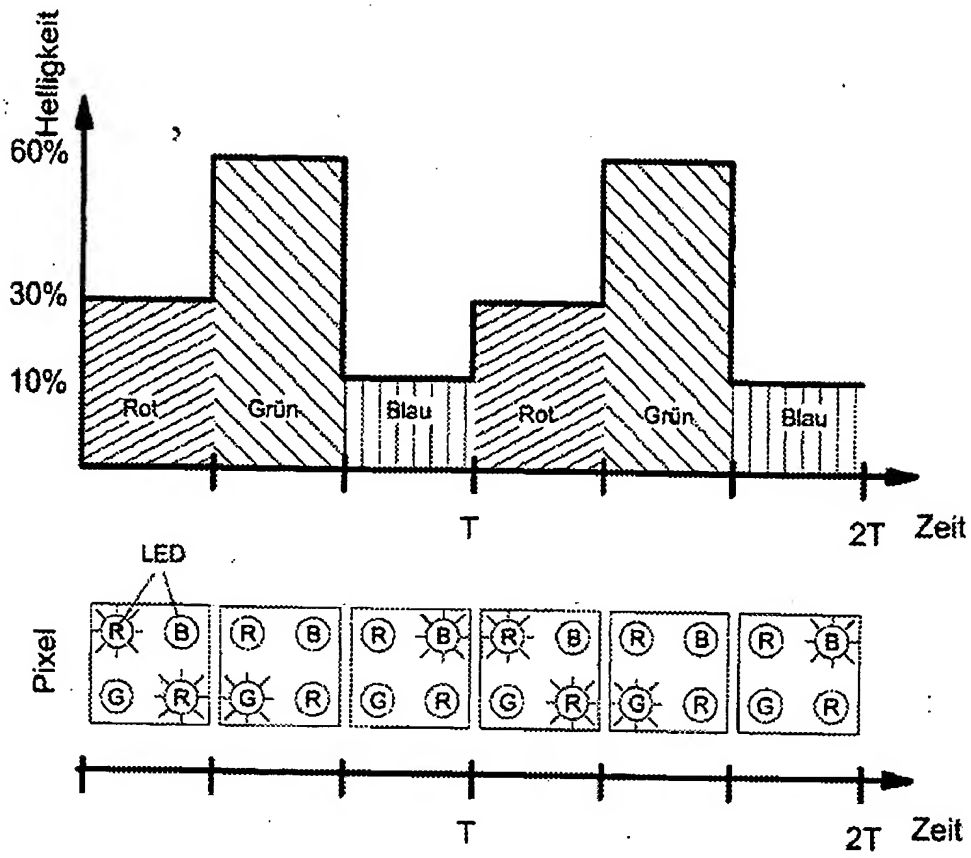

Figur 1

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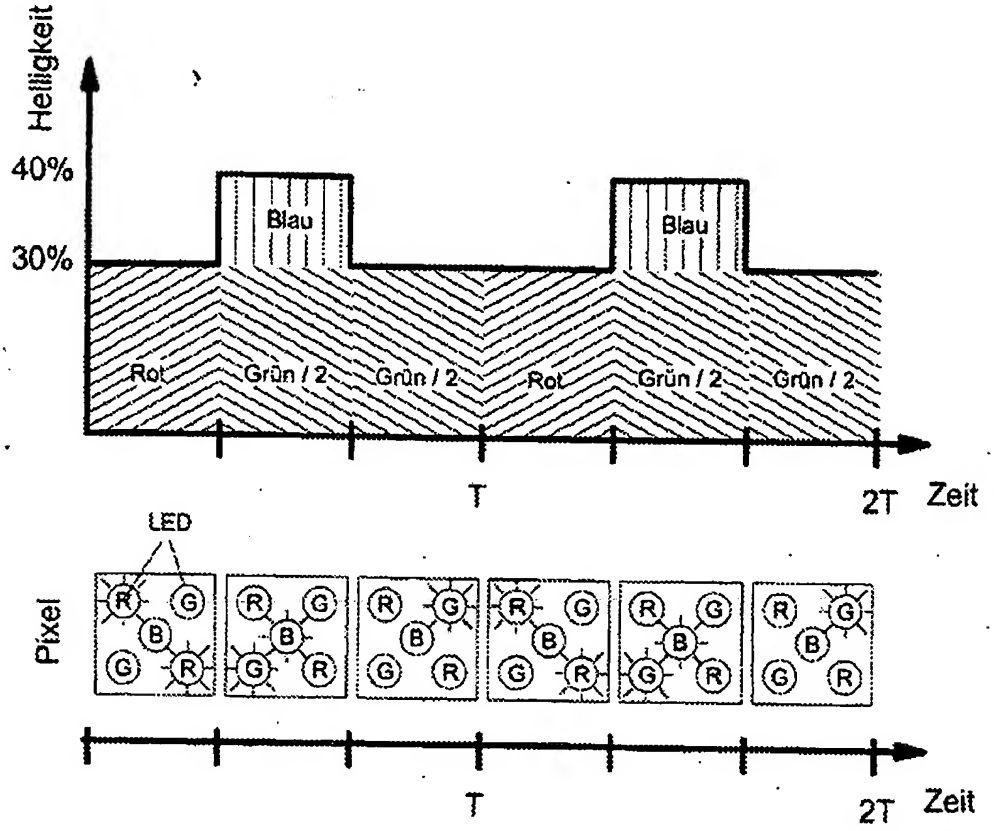

Figur 2